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# The flow of materials in the European Bronze Age: scales, data-classes, and the prospects for integration from a metallurgist's perspective

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## Abstract

The mutability of copper-alloys creates the potential for complex material life stories. It is possible for units of metal to merge, split, be recycled, enter the ground, be reclaimed, and be cast into a series of forms before final deposition. This paper discusses the use of archaeological science to directly characterise processes that have often been the domain of theorists and modellers. Progress has been made on a series of fronts for copper-alloys: new data visualisations, chemical classification systems, quantifying chemical changes caused by oxidation and mixing, and determining the degree and modes of recycling. Overall, it may be possible to build upon a provenance model to understand the socially embedded process of metal 'flow' through prehistory. Even if this work on (some) metals is successful, we are again in danger of describing an unrealistic system: replacing a provenance model with an isolated concept of the way metal moved through society. Instead we ideally want to study how a series of materials, technologies, landscapes, and societies intertwined and interacted. The second half of this paper therefore considers the practicalities of merging the large scientific datasets that are becoming available for metal chemistry and isotopes, stone and ceramic petrography, and organic materials. Key questions that will be addressed include: on what scale is integration feasible, how can GIS-databases be best used, and what primary science is still required?

**Keywords:** Copper, alloy, Bronze Age, Chemical analysis, Recycling, Flow, Database, GIS

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